SOUTHWEST RESEARCH INSTITUTE®
QUARTERLY STATUS AND PROGRESS REPORT
FOR PERIOD ENDING MARCH 31, 2005

OTHER TRANSACTION AGREEMENT DTRS56-02-T-0001
SwRI® PROJECT 14.06162

APPLICATION OF REMOTE-FIELD EDDY CURRENT (RFEC) TESTING TO INSPECTION OF UNPIGGABLE PIPELINES

Phase 2–Design of RFEC System for Integration with Explorer II Robot

Many pipelines contain internal restrictions that do not allow the passage of inspection pigs that use conventional inspection technology. In the current phase of this project, a remote-field eddy current (RFEC) system is being designed to accommodate internal restrictions**.** This system is designed for integration with the Explorer II robot under development at Carnegie Mellon University.

The Explorer II robot consists of a series of 11 modules that are linked together to form a self-propelled device that can travel untethered through a pipe. The robot is designed for pipe that ranges in diameter from 6 to 8 inches. In order to accommodate sharp bends in the pipe, however, the robot must have the capability to collapse to 4 inches in diameter**.** The system concept for adding RFEC capability is to develop modules that can be added to the Explorer to accommodate RFEC. Designs were developed for RFEC exciter and detector modules that meet these size requirements. The detector module contains a series of 48 sensors on spring-loaded, retractable arms. The arms expand to the required pipe diameter and retract as necessary to negotiate bends or obstacles in the pipe.

In January 2006, SwRI (along with other sensor providers) participated in demonstration testing at Battelle. Tests were performed on three 8-inch-diameter pipes containing numerous external corrosion-type defects. Except for four calibration defects of known size, all of the defects were hidden from view, and the dimensions were not disclosed at the time of the test. Based on analysis of the RFEC signals, SwRI reported defect characteristics (length, width, and depth) to Battelle.

During the current reporting period, the demonstration test results were made available by Battelle. The SwRI RFEC tool detected 100% of the 32 defects with only one false positive. (The false positive was based on a signal that was repeatable, but did not have typical flaw signal characteristics.) In the Battelle report, graphs of results showed “True” values versus “Measured” values for the depth, length, and width of the defects. The graphs included plus and minus error bands that were based on ±10% of wall thickness for depth and ±0.5 inch for length and width. Since no statistical results were given, SwRI developed a simple metric based on the number of data points within those error bands. The percent of total measurements within these error bands was 88% for defect length, 90% for defect width, and 68% for defect depth. The depth measurements were uniformly somewhat low, indicating a systematic error in the depth conversion algorithm. If that error were backed out, the SwRI depth performance would be increased from 68% to approximately 84% within error bands.

Point of Contact

Gary L. Burkhardt, Staff Scientist
Applied Physics Division
Southwest Research Institute
6220 Culebra Road
San Antonio, Texas 78238
(210) 522-2075
(210) 684-4822 fax
gburkhardt@SwRI.org